The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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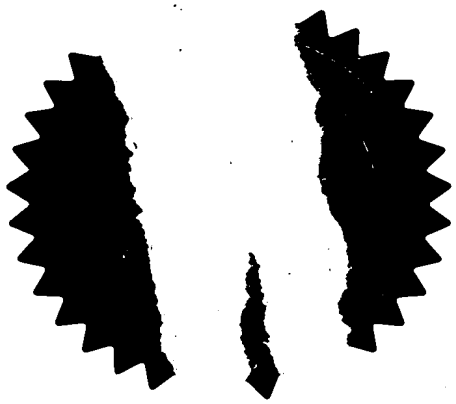


Signed

Dated 30 October 2003

Patents Form 1/77

Patents Act 1977
(Rule 16)

The Patent Office

22OCT02 E857412-1 [illegible]
P01/7700 0.00-0224439.0

1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

1. Your reference — MJN/67978/000 — 0224439.0

2. Patent application number
(The Patent Office will fill in this part)

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

ABB Offshore Systems Limited
2 High Street
Nailsea
Bristol BS48 1BS

Patents ADP number *(if you know it)* 7692221001

If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom (GB)

4. Title of the invention — MONITORING A MICROSEISMIC EVENT

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

PAGE HARGRAVE
Southgate, Whitefriars
Lewins Mead
BRISTOL BS1 2NT

Patents ADP number *(if you know it)* 05996483001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	-
Description	2
Claim *(s)*	1
Abstract	1
Drawing *(s)*	-

10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	Two
Request for preliminary examination and search *(Patents Form 9/77)*	One
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature PAGE HARGRAVE Date 18/10/02

12. Name and daytime telephone number of person to contact in the United Kingdom: Mr M J Newstead (0117) 927 6634

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

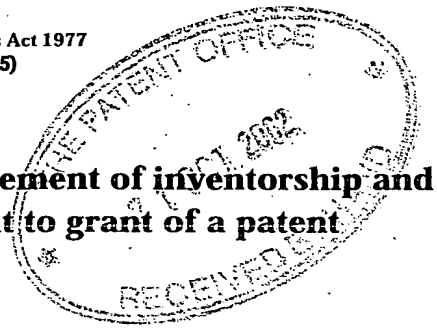
d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

Patents Form 7/77

Patents Act 1977
(Rule 15)



The Patent Office

7/77

Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

1.	Your reference	MJN/67978/000 0224439.0
2.	Patent application number *(if you know it)*	
3.	Full name of the or of each applicant	ABB Offshore Systems Limited
4.	Title of the invention	MONITORING A MICROSEISMIC EVENT
5.	State how the applicant *(s)* derived the right from the inventor *(s)* to be granted a patent	By virtue of a contract of employment between the applicant and the inventor.
6.	How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*	-
7.		I/We believe that the person *(s)* named over the page *(and on any extra copies of this form)* is/are the inventor *(s)* of the invention which the above patent application relates to. Signature [signature] Date 18/10/02 PAGE HARGRAVE
8.	Name and daytime telephone number of person to contact in the United Kingdom	Mr M J Newstead (0117) 927 6634

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.

d) When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.

e) Once you have filled in the form you must remember to sign and date it.

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

Robert Hughes Jones
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United Kingdom (GB)

Patents ADP number *(if you know it):*

6502082002

Patents ADP number *(if you know it):*

Patents ADP number *(if you know it):*

Reminder

Have you signed the form?

MONITORING A MICROSEISMIC EVENT

The present invention relates to monitoring a microseismic event.

Microseismic data is continuously received from microseismic sensors fitted in producing fluid wells, such as hydrocarbon producing fluid wells. Triggering algorithms are an important aspect of microseismic monitoring in that they are the mechanism by which the microseismic signals are detected. Algorithms are required that can discriminate between background noise, that may vary with time, and microseismic signals, that may also vary between events. The algorithm runs in real-time and so simplicity of computation is also an advantage.

Microseismic monitoring in producing fluid fields, for example oil fields, may mean monitoring in the presence of high levels of electrical noise. One source of electrical noise comes from the use of electrical currents for cathodic protection, particularly of the items in a well borehole. The cathodic protection current is DC, which is typically derived from an AC mains supply by rectification. This leads to a DC current that contains frequency peaks typically at 50 Hz, 100 Hz, etc. This large, peaky current invariably finds its way into the electrical outputs of the sensors and can make finding microseismic signals difficult.

There are several types of well known existing seismic triggers. The simplest is just the detection of a signal level change. A more sophisticated trigger is to look for a level change that occurs across several separate stations within a pre-defined time window. Another variation on this is to use a long term-short term average to cause a trigger. This is just the short-term average of a rectified signal divided by the long-term average of the rectified signal. The ratio of long-term to short-term is typically around a factor of nine.

In the presence of the multi-frequency noise described above, neither of the trigger algorithms described in the previous section is effective. What is required is an accurate model of the noise that, although it is well characterised locally, does change over time.

According to the present invention, there is provided a method of monitoring a microseismic event, comprising: detecting said event to produce a first signal dependent on said event, the first signal including noise at a frequency of f Hz; taking a first sample of said first signal; taking a second sample of said first signal, the second sample occurring n/f seconds after the first sample, where n is an integer; and subtracting the first and second samples from each other to produce a further signal dependent on said event in which said noise has been at least partly compensated for.

The integer could be 1.

The frequency fHz could be 50 Hz for example, or a harmonic of 50 Hz.

The method could be one in which the microseismic event is one occurring in a fluid producing well

In one example, although the noise contains all harmonics of, typically, 50 Hz, it has been found that by subtracting the current sample from a sample that occurred 20 milliseconds before, typically well over 90% of the noise energy is removed. An existing trigger detection algorithm can then be used and levels of detection become similar to those that are achieved when no noise is present. This approach works because all the noise spikes are harmonics of the typically 50 Hz fundamental, which is a property of the rectification process that is used in creating the DC.

CLAIMS

1. A method of monitoring a microseismic event, comprising: detecting said event to produce a first signal dependent on said event, the first signal including noise at a frequency of f Hz; taking a first sample of said first signal; taking a second sample of said first signal, the second sample occurring n/f seconds after the first sample, where n is an integer; and subtracting the first and second samples from each other to produce a further signal dependent on said event in which said noise has been at least partly compensated for.

2. A method according to claim 1, wherein $n = 1$.

3. A method according to claim 1 or 2, wherein $f = 50$.

4. A method according to any preceding claim, wherein the microseismic event is one occurring in a fluid producing well.

ABSTRACT

A method of monitoring a microseismic event comprises detecting the event to produce a first signal dependent on the event, the first signal including noise at a frequency of f Hz (e.g. 50 Hz); taking a first sample of the first signal; taking a second sample of the first signal, the second sample occurring n/f seconds after the first sample, where n is an integer (e.g. 1); and subtracting the first and second samples from each other to produce a further signal dependent on the event in which the noise has been at least partly compensated for.